The ERM Group

RESPONSE TO EPA'S FOCUSED
FEASIBILITY STUDY FOR THE
TYSON'S SITE

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Prepared for

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SECTION 1

INTRODUCTION

1.1 Purpose and Objectives

In July 1986, CIBA-GEIGY Corporation received a copy of the Focused Feasibility Study (FFS) for the Tyson's Site and a Risk Assessment (RA) prepared by ICF-Clement. These documents represent the culmination of a series of activities, investigations, and reports conducted by the United States Environmental Protection Agency (EPA) Region III and its contractors at the Tyson's Site in Upper Merion Township, Montgomery Township, Pennsylvania.

CIBA-GEIGY Corporation and its consultant, Environmental Resources Management, Inc. (ERM) consider the FFS and RA and all supporting previous investigations leading to the FFS and RA so fundamentally flawed as to result in both an incomplete and improper assessment of the site. Subsequently the EPA's conclusions and recommendations have led to the selection of an inappropriate remedial action.

The objectives of this ERM response to the FFS and RA are to show the following:

- EPA has conducted a series of incomplete investigations which have led to the improper assessment of the site hydrogeologic framework, source of contamination, and risk associated with the site,

- EPA has chosen to ignore the bedrock aquifer beneath the site although it has repeatedly mentioned that flow through the bedrock aquifer may be a pathway of contaminant migration,

- EPA has identified the former lagoon area and apron area around the lagoons as being the primary source of contamination, which is being shown to be wrong, as previously indicated by ERM.

- EPA's failure to understand and properly describe the hydrogeologic framework has led to an erroneous assessment of exposures related to the site. Exposure modeling used by

EPA falls well short of a 'state-of-the-art' assessment and is not a sound basis for decision making.

- EPA's analysis of alternatives relies on the RI and FS to reaffirm its belief in the effectiveness of excavation. These assessments do not consider principal migratory pathways from the site and reach erroneous conclusions. The effectiveness of excavation is questionable because the major source of contaminants is located off-site and because of the risks posed by releases that will occur during excavation.

The following sections of this response present supporting evidence to the above items which will show that the FFS and RA and indeed all investigations preceding these documents have been fundamentally flawed. Much of the information and data presented in this document are from work being conducted by ERM for CIBA-GEIGY in the off-site area. This off-site area investigation (also called the Off-Site Operable Unit RI) includes the study of the bedrock aquifer. EPA chose not to conduct this investigation prior to selecting its remedial action for the former lagoons although ERM and CIBA-GEIGY repeatedly warned them that this information was necessary for selecting an appropriate remedial action for the site.

SECTION 2

STATED OBJECTIVES OF THE FOCUSED FEASIBILITY STUDY

2.1 Objectives

There is no specific stated purpose or list of objectives for the FFS. However, there are two statements within the FFS which can be considered as the intent of the document. These comments are found on page 5 of the report, paragraph 3 and the first sentence of paragraph 4 respectively:

- "In summary, the main remedial action objective will be to prevent or minimize the release of hazardous substances into the surficial aquifer from the subsurface soils outside of the former lagoon area"[1].
- "The objective of the discussion is to present as representative an exposure model as possible of contaminant transport in the surficial aquifer only."

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[1]The EPA has not clearly defined what they mean by the "surficial aquifer", however by strong inference it is comprised of the unconsolidated deposits overlying bedrock, since the EPA does clearly define the bedrock aquifer. The EPA "surficial aquifer" is shown to be continuous from the former lagoons (on-site) to and through the floodplain area (off-site) on the cross-section in the FSS located between pages 4 and 5. This continuous "surficial aquifer" is then considered to be the major pathway of migration in the ICF-Clement RA. This description of the hydrogeologic setting is incorrect and the subsequent risk assessment is fundamentally flawed as described in Section 3.2 below and as shown on Figure 3-1B.

Throughout the remainder of this document ERM will refer to the "surficial aquifer" as the shallow aquifer and the deep aquifer as the bedrock aquifer. This is obviously somewhat confusing, however, ERM wishes to quote EPA where necessary and EPA uses the terms interchangeably.

2.2 Flaws in the Stated Objectives

The stated objectives of the FFS as presented above are not appropriate. CIBA-GEIGY and ERM have repeatedly stated that it would be impossible to properly assess the Tyson's Site without studying the bedrock aquifer. Data being obtained by ERM during the Off-Site RI show that:

- EPA has not properly interpreted the hydrogeologic setting of both the on-site and off-site areas.
- The apron areas and indeed the lagoons themselves are not significant sources of contamination,
- As EPA states in the FFS, the bedrock aquifer cannot be ignored,
- By choosing to ignore actual site conditions and the bedrock aquifer the exposure model is totally nonrepresentative of site conditions,

Additionally, ERM will show in the following sections that EPA's exposure assessment, alternative analysis, and toxicity assessment are also inappropriate.

SECTION 3

SITE HYDROGEOLOGIC FRAMEWORK

3.1 Hydrogeologic Framework as Presented in the FFS

It is interesting to note that the FFS on page 4, paragraph 2 reads "the principal transport medium to complete an exposure pathway from this source is for contamination migration through both the shallow and deep aquifers." By this source EPA is referring to the contaminated soil found outside the former lagoon areas. The paragraph goes on to state "A quantitative risk assessment prepared by ICF-Clement discusses this exposure route in greater detail (chapter 4)." From this point on the FFS chooses to look only at the shallow aquifer although as expressed above to complete an exposure pathway it is necessary to look at both the shallow and deep aquifers. Once again for clarification the shallow aquifer that EPA refers to is ground water in the unconsolidated materials and the deep aquifer is the bedrock aquifer. Throughout EPA's work at the Tyson's Site it has repeatedly stated the importance of the deep or bedrock aquifer but has consistently failed to consider it in site evaluations.

With regards to the RA conducted by ICF-Clement the only two comments made on the deep aquifer in chapter 4 are: 1) that more work on the deep aquifer is needed, and 2) that the water quality in the shallow bedrock aquifer is believed to be reflected by the water quality in the surficial aquifer. This second point has been proven wrong by data collected during the Off-Site RI. By ignoring the bedrock aquifer EPA has biased its analysis apparently to support its previously selected alternative.

EPA presents a generalized geologic cross section between pages 4 and 5 of the FFS (shown as Figure 3-1A of this report). This generalized geologic section is used to show the relationship between the "surficial aquifer" on-site and a contaminant migration pathway to the river via the unconsolidated materials. The EPA cross section shows that the unconsolidated materials continuously overlie bedrock from the former lagoon area to the Schuylkill River. This relationship is used throughout the FFS and RA to describe ground water flow and contaminant migration through the "surficial aquifer."

3.2 Hydrogeologic Framework as Defined by Work Conducted During the Off-Site RI

EPA's conceptualization of the surficial aquifer is wrong. A true description of the hydrogeologic framework based upon actual field data and observations is discussed below.

There is no direct connection between the localized on-site unconsolidated materials and the off-site surficial aquifer present in the alluvial deposits overlying bedrock. Figures 3-1A and B are two cross sections. The top cross section is the one presented in the FFS. The bottom cross section was drawn from actual field data obtained during the Off-Site RI. On Figure 3-1B shows that there is no direct connection between the EPA so called on-site "surficial aquifer" in the lagoon area and the surficial aquifer in the flood plain since there is considerable exposed bedrock between the former lagoons and the railroad.

Figures 3-2 through Figure 3-4 are photographs showing:

- bedrock outcrop downgradient of the eastern set of lagoons (Figure 3-2)
- bedrock outcrop downgradient of the western set of lagoons (Figures 3-3)
- exposed bedrock surface in the vicinity of the eastern set of lagoons.

These bedrock exposures, so critical to the evaluation of the site hydrogeologic framework, should have been identified during EPA's many site investigations.

The importance of these outcrops at land surface between the lagoons and immediately down slope of the lagoons at the railroad embankment is that they indicate that the lagoons were clearly excavated to or into the underlying bedrock. While seepage into the localized unconsolidated materials (i.e., the apron area) has been documented virtually all of the liquid wastes placed into these lagoons would have direct hydraulic connection to the fractured bedrock aquifer. Therefore, use of the surficial aquifer as a pathway of contaminant migration directly to the river is wrong.

EPA has also incorrectly identified the unconsolidated materials in the area of the former lagoons as a "surficial aquifer". In reality the following is true:

Figure 3-1A
Generalized Geologic Cross Section As Presented and Used By EPA in the FFS

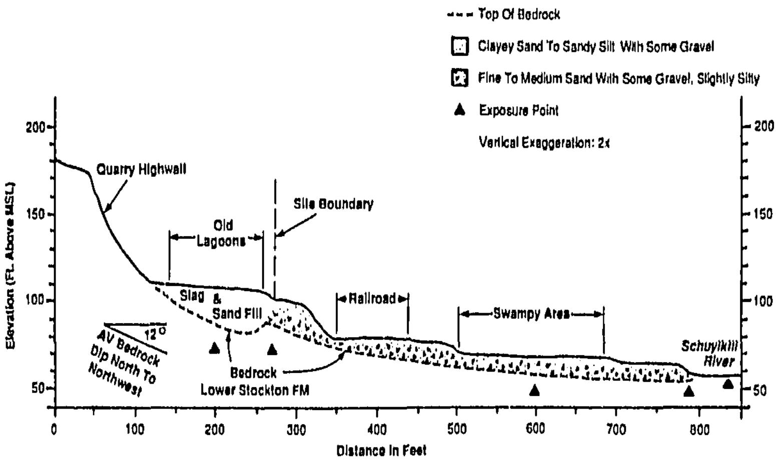

Figure 3-1B
Generalized Geologic Cross Section As Modified By ERM, Based Upon Actual Field Data, To Show True Site Hydrogeologic Conditions

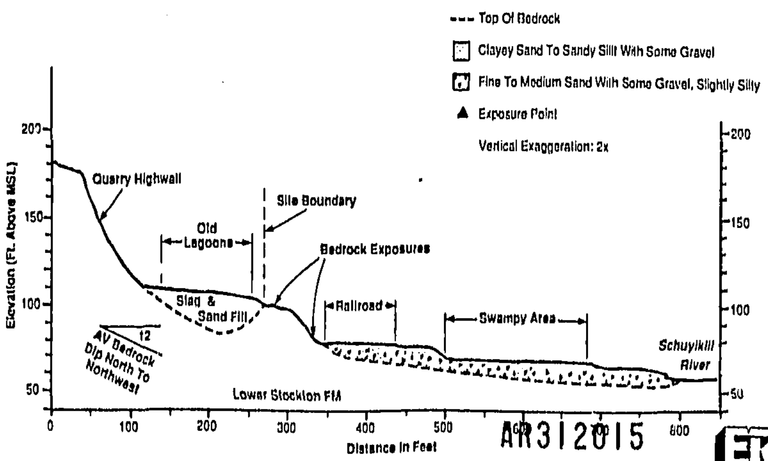

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Figure 3-2. Bedrock outcrop downgradient of eastern set of lagoons.

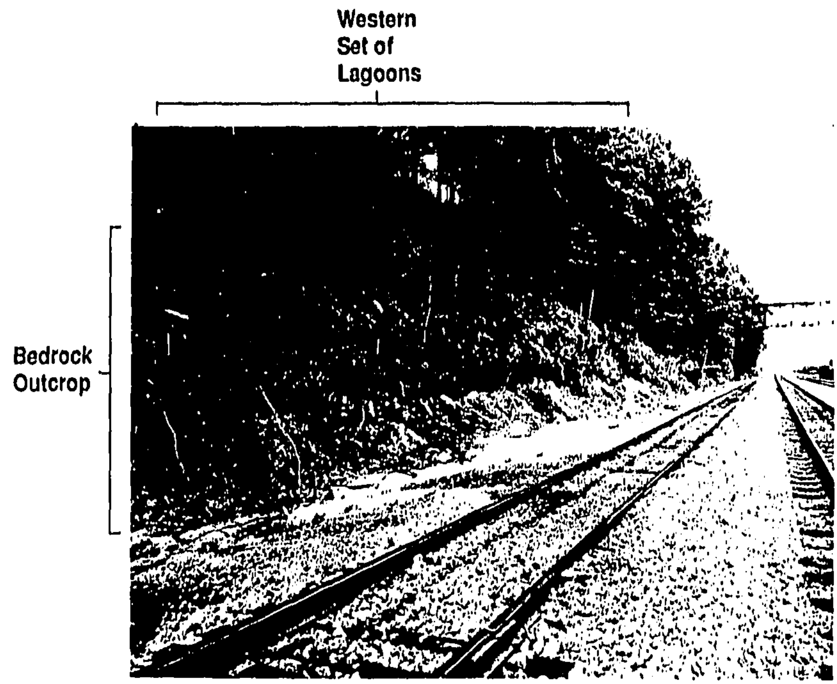


Figure 3-3. Bedrock outcrop downgradient of western set of lagoons.

- this material is seasonally unsaturated. In the coarse of the off site RI conducted by ERM during the first half of 1986, depth to water measurements have shown that most of EPA's monitoring wells completed in these materials were dry for at least some of this period; in addition one of EPA's conclusions from the RI report is that the lagoons in the western portion of the site do not intercept the ground water table.
- it is ERM's opinion that the majority of the water found in this material which might be considered as ground water is actually "temporarily perched" water which is ponded on the low permeability tar-like materials left in the bottom of the former lagoons after closure. This water then slowly percolates into the bedrock beneath the lagoons.
- by EPA's own description; "aquifer... is capable of yielding a significant amount of water to a well or spring". By this definition there is no on-site surficial aquifer and seasonally no water is available at all.

Failure to recognize the true nature of the hydrogeologic framework has led to a completely erroneous interpretation of contaminant migration from the former lagoons and apron area as described in the FFS and therefore selection of a premature and ineffective remedial action by the EPA.

SECTION 4

SOURCE OF CONTAMINATION

4.1 Contaminant Source is misidentified in the FFS

The first sentence on Page 5, paragraph 2, of the FFS reads "A key factor in assessing the impact to the river is the quantity of leachate and contaminated ground water which migrates from the source of contamination - that being the former lagoon areas."

4.2 Contaminant Source as Identified in the Off-Site RI

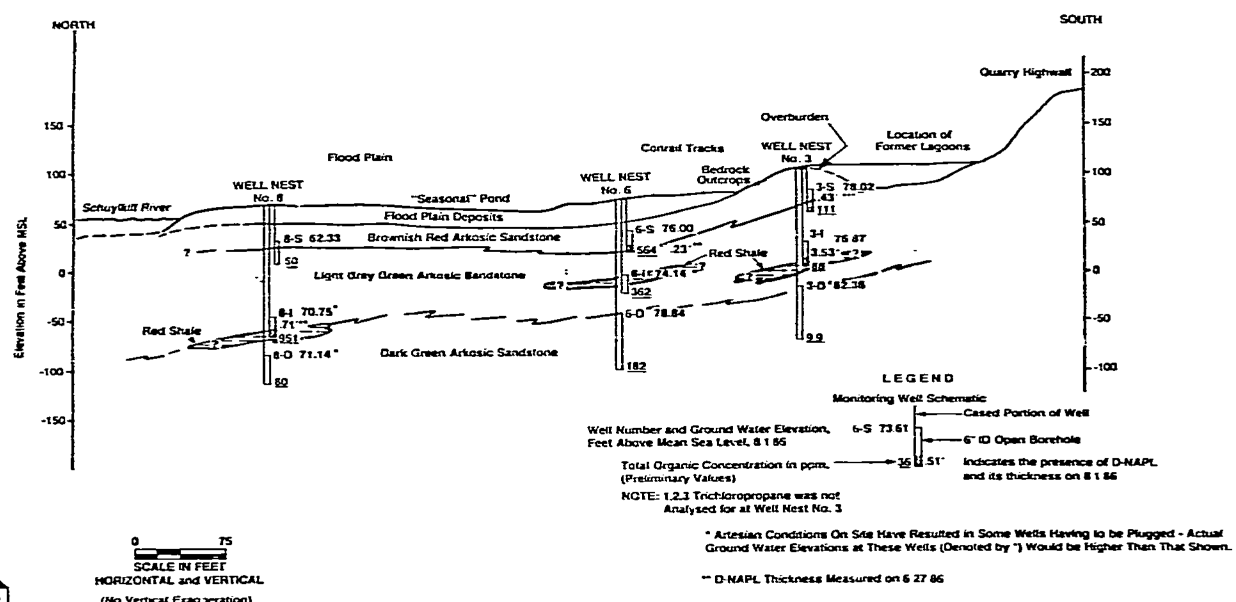
The primary source of contamination at the Tyson's Site is not the former lagoons but rather the contaminated ground water in the bedrock beneath the lagoons and the flood plain. Preliminary results from the work being conducted in the Off-Site RI are presented in Figure 4-1, a detailed cross section drawn along the line extending from the eastern most set of former lagoons to the river. Included on this cross section are well construction data, total organic contaminant concentrations (HSL volatile and base/neutrals) in parts per million and any Dense Non Aqueous Phase Liqid (DNAPL) present. The preliminary data show:

- Significant thicknesses of DNAPL (up to about four feet) have been found throughout the bedrock aquifer as far north as the Schuylkill River and as deep as 137 feet below land surface.

- The total organic concentration in parts per million in the bedrock aquifer is considerably higher than that detected in any of the shallow wells installed during the On-Site RI/FS including the shallow wells installed in the former lagoon area.

- Concerning the total volume of materials remaining in the lagoons and the concentrations of dissolved contaminants and DNAPL in the bedrock aquifer, it can safely be said that virtually all (refer to attached report by S. Feenstra and J. Cherry) contamination associated with the Tyson's Site has migrated out of the former lagoons and that which remains in the former lagoons and apron area is insignificant. Therefore excavation of the apron area as discussed in the FFS or the former lagoons is not expected to have a measurable effect on the water quality in downgradient ground water or in the Schuylkill River.

Figure 4-1
Cross Section Based On Data Collected During ERM's Off-Site RI



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SECTION 5

EXPOSURE ASSESSMENT

5.1 Description of EPA's Approach

EPA has calculated exposures at various receptor locations using a combination of partition coefficients in the unsaturated zone and river, and the VHS model in a sand and gravel formation overlying bedrock. To accomplish this EPA generated calculations described as follows:

- generation of pore water concentrations from contaminated soil areas (Cp)

- calculation of ground water contamination in the on-site aquifer (Ca). It is strongly inferred that this is the 'surficial aquifer' as defined by ICF-Clement.

- calculation of ground water contamination at the Schuylkill River bank prior to discharge (Crb)

- calculation of surface water contamination after discharge to the Schuylkill River (Cr)

- calculation of surface water contamination at the down-river water intake (Ci)

Contamination in the unsaturated zone pore water (Cp) was calculated using a partition coefficient (Kp) representing the fraction of contaminant present in the pore water as a function of contaminant present in the soil.

Contamination of water present in the so called on-site "surficial aquifer" (Ca) was calculated by a mass balance technique. The amount of soil that EPA calculates as necessary to be excavated is based upon protection of a drinking water supply at Ca. Infiltration through the contaminated area was estimated to be 35 inches per year by EPA. The upgradient ground water flow was determined using an infiltration of 20.5 inches throughout the contributing watershed, not including the apron area. The upgradient ground water flow dilutes Cp in the infiltrating water to Ca which is presumably located in deposits at the edge of the apron area. For the other ground water receptor points (Crb and Cr), EPA relied primarily upon the ICF-Clement RA. This document used the VHS model to predict concentrations in the shallow aquifer. To obtain concentrations at the Schuylkill River receptor points (Cr and Ci), the calculations are based on a mass balance followed by a partition coefficient and decay through volatilization.

5.2 Critique of EPA's Exposure Assessment

EPA's estimates of receptor point concentrations at Ca which are used to calculate the amount of soil to be excavated are incorrect because of errors in the unsaturated zone and in the water balance calculations used to derive the Ca values.

5.2.1 Unsaturated Zone Calculations

ICF-Clement has calculated unsaturated zone pore water concentrations of contaminants by a simplified technique. Unfortunately, unsaturated zone processes are complex and not well-suited to this type of approach. In such cases it is important to calibrate the model to field data. This is a straight-forward procedure and its omission is a fatal flaw in EPA's approach.

Calculations conducted by ICF-Clement to obtain pore water concentrations (Cp) were based on the Freundlich isotherm. This approach was presented by EPA as an interm approach for metals only. On November 27, 1985, EPA proposed an approach for evaluating organic wastes (organic Leachate Model-OLM). The OLM would predict concentrations which would be an order-of-magnitude less than the method used by ICF-Clement.

5.2.2 Water Balance Calculations

EPA's water balance calculations are incorrect as described below because it did not accurately determine infiltration rates or the interconnection with other lithologic units. Infiltration estimates used by EPA are clearly very gross. EPA and ICF-Clement have used many different estimates in the FFS and RA. ICF-Clement states on p. 5-4 of the RA, "Further investigation is required to refine the preliminary water balance presented above. This should include a field study to investigate whether there is a hydraulic connection between the water table and bedrock aquifers. In addition, a detailed water balance model...should be used in conjunction with a broad meteorological data base."

ERM concurs with ICF-Clement on this entire statement. Each step of the water balance calculation must be carefully considered. ERM has made some site-specific calculations for various cap designs as discussed in Section 8. These were easily accomplished using local climatological data sets. EPA chose to ignore its contractor's caution and once again made an estimate based upon incomplete data analysis.

The water balance calculation is sensitive to the amount and rate of vertical leakage with other units to lower lithologic units. There is clearly no aquitard preventing leakage from the overburden deposits and weathered bedrock to the bedrock itself at the Tyson's Site (see Section 3.0 above for a full discussion of site geology). Because leakage does occur, the water balance calculations and resultant contaminant concentrations are in error.

5.2.3 Modeling conducted in the FFS and in the RA is fundamentally flawed.

Models were used in the FFS and RA to calculate the concentration of contaminants at on-site receptor points, including Ca, on which the excavation volume calculations are based, as well as, off-site receptor points in the 'surficial aquifer' and in the Schuylkill River. The modeling methodology used in both the FFS and the RA cannot be considered as a sound basis for decision-making,because each of the fundamental steps required in modeling were either ignored or incorrectly performed. This issue is discussed at length in Section 3.0 of the Response to the Risk Assessment which is entitled "Critique of Modeling". Since the modeling in the FFS is merely a variant of that conducted in the RA the same criticisms apply to the FFS.

The first, and most important, element in any modeling exercise is an appropriate conceptual representation of the system under study. Boundary conditions and connections between lithologic units must be accurately identified. This has not been accomplished at the Tyson's Site by EPA's own admission since it made no attempt to include bedrock as a source, transport pathway or sink in its conceptualization of the movement of contaminants from the lagoons and on-site soils. In Section 3, this has been shown to be a fundamental error.

The models used by EPA did not rely on field measurements to quantify critical hydrologic parameters (aquifer thickness, and ground water velocity). In addition, calibration or validation of the ground water model was not performed.

There are many other problems with the model which are discussed at length in the Response to the RA. To refute the validity of the modeling effort, however, we consider it necessary to mention only one additional point in the present discussion. The VHS model was incorrectly applied, leading to serious errors in estimation. The resultant model did not satisfy the most basic of modeling principles - the conservation of mass. The model shows much greater flow of polluted ground water entering the river than is flowing under the site. ERM considers any model which violates such fundamental principles as quite useless for decision-making.

SECTION 6

ALTERNATIVES ANALYSIS

6.1 Description of EPA's Approach

EPA considers only excavation alternatives since it claims that the 1984 ROD contains a pertinent alternatives analysis. The purpose of EPA's analysis is to evaluate the effectiveness of various amounts of excavation. Effectiveness is measured primarily in terms of the alternative's ability to meet Action Levels at the exposure points discussed in Section 5.

EPA categorized alternatives into those which:

- attain applicable and relevant Federal public health or environmental standards (Category A)
- exceed those standards (Category B)
- do not attain applicable or relevant standards but which will reduce the likelihood of present or future threat and which provide significant protection (Category C)
- no action (Category D)

The selected remedy was to excavate so that at receptor Ca the carcinogenic risks would not exceed 10^{-6}. EPA claims that this may serve as an Alternate Concentration Limit (ACL) subsequent to RCRA, Subpart F. Therefore EPA states this alternative can be described as satisfying Category B, above.

6.2 ERM's Critique of EPA's Alternatives Analysis

6.2.1 EPA's Approach

EPA's objective in the FFS is to evaluate action levels for remediation of the apron area. The only alternatives considered are no action and various forms of excavation. EPA's rationale for ignoring other types of alternatives was that the 1984 ROD for the lagoons identified excavation as the only acceptable and still relevant alternative. In the 1984 ROD, the excavation alternative was selected because of its "reliability in

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eliminating the continued generation and off-site migration of leachate from the former lagoon locations and the continued contamination of both shallow and probably deep ground water zones."

Based on current knowledge of the site and the hydrogeological setting, this statement is no longer defensible since significant contamination of the deep ground water has already occurred and DNAPL has been found in bedrock in the off-site areas. Excavation of the lagoons or of the apron area will have an insignificant effect on overall ground water contamination. In addition, if other alternatives were subjected to the same modeling analysis as conducted in the FFS, it would be found that they would be as effective as excavation. This is because in the model the contaminants are generated by infiltration through the site soils. EPA's model would effectively restrict infiltration and thus very little contamination would result. Therefore using EPA's own procedure the capping alternative would become just as effective as excavation and would be obviously much more cost effective. Section 8 of this report discusses the effectiveness of a cap in reducing infiltration in detail.

6.2.2 EPA Does Not Consider Risks Posed by Excavation

EPA has not given proper weight to the environmental and public health risks posed by excavation compared to the relatively slight risks posed by keeping the materials in place.

Dechert, Price and Rhoads presented a summary of the risks and consequences of excavation in a previous submittal containing comments on the RI/FS (November 7, 1984) including:

- volatilization of contaminants from site soils during excavation
- more rapid infiltration of water and contaminants
- neighborhood disruption estimated to be for a duration of twelve weeks in the RI
- displacement of wastes to an off site facility presents new risks at that location

The removal of waste by truck will lead to an enormous increase in truck traffic in the adjacent residential neighborhood. Truck volume would be 3000 round trips over the twelve week period, amounting to thirty-five trucks over a six hour day.

6.2.3 EPA Has Not Identified Reasonable Receptor Locations

There is essentially no potential for ground water use between the Tyson's site boundary and the river. The railroad tracks have limited access and are certainly not suitable for well development. There are strong federal environmental policies requiring protection of the flood plain area and restricting federal involvement which would disturb the ecology in this wetland area. Executive Order 11990, issued in furtherance of the National Environmental Policy Act, 42 U.S.C. 4331(b)(3), specifically commands federal agencies to avoid undertaking or providing assistance for construction in wetlands unless there is "no practicable alternative to such construction". A similar mandate is included in Executive Order 11988 constraining federal agencies from any construction in flood plain areas except where no practicable alternative exists and even then, only after a detailed consideration of alternatives and ways to minimize potential harm. These conditions will effectively preclude well development in the flood plain area.

EPA has elected to determine the extent of required remedial action based on the protection of humans ingesting ground water withdrawn from the "surficial aquifer" below the apron area (Ca). Apart from the technical problems encountered with EPA's calculations and methodology in developing these action levels, ERM takes issue with the selection of the receptor point itself.

EPA claims that the receptor point values are based on an ACL approach. However, its evaluation is very restrictive. ACLs can be applied to protect against actual exposures within and outside the property boundary. In this case, an ACL could probably be developed based upon protection of water uses in the Schuylkill River, including aquatic life and ingestion of drinking water. However, a final selection of the most appropriate receptor must await the results of the off-site RI/FS. EPA is currently reviewing a large number of ACLs which are based on protection of surface water in cases where ground water is not used. In such cases, ACLs can be applied by requiring institutional controls. Such an approach has been documented in one of the ACL case studies being prepared by EPA Headquarters. In that case, involving a closed waste facility in the northeastern US, the ACL will be based upon the owners purchasing the water rights for a 100-acre parcel of land surrounding the facility. The Tyson's Site is well-suited to such an application of an ACL.

SECTION 7

TOXICOLOGICAL EVALUATION

7.1 Description of EPA's Approach

EPA relies upon the ICF-Clements RA to establish: risk levels for on-site carcinogens, hazard index values for non-carcinogens; and levels for the protection of aquatic life. ICF-Clement considered 1,2,3-trichloropropane as a possible human carcinogen and developed a Carcinogenic Potency Factor (CPF) based on the potency for 1,2-dichloropropane.

7.2 Critique of EPA's Approach

The uncertainty related to establishing a CPF for 1,2,3-trichloropropane (TCP) is much greater than for the other indicator parameters. This source of uncertainty relates to the following questions:

- is TCP a carcinogen?
- if so, how potent is it?

1,2,3-Trichloropropane is contained in the RCRA identification and listing of hazardous waste (October 30, 1980, USEPA). At that time no data was available for possible carcinogenicity, mutagenicity, teratogenicity or chronic toxicity of TCP. Preliminary mutagenicity studies conducted by the National Institute of Health suggest positive results for chromosomal aberrations and sister chromatid exchange as well as several strains of salmonella. However, further studies are being conducted to determine TCP's mutagenicity. The National Toxicology Program (NTP) has evaluated TCP in 120 day gavage toxicity studies in B6C3F1 mice and Fischer 344 rats. The preliminary data indicate some evidence of hepatic injury, however, the final peer-reviewed report is currently unavailable. Long-term (2 year) bioassays in rats and mice were started in June 1985 for completion in June 1987 with an interim evaluation due in November 1986. Thus at the present time, data on 1,2,3-trichloropropane are insufficient for a scientific evaluation of its carcinogenicity.

With regards to the carcinogenicity of 1,2-dichloropropane, EPA appears to have relied on a two-year bioassay study conducted by the National Toxicology Program (NTP) which has not undergone peer review nor been released in its final form. Preliminary results from such a study do not satisfy internationally-accepted criteria for sufficient evidence of carcinogenicity, even in experimental animals and are certainly inadequate to make any determination with respect to cancer in man.

ICF-Clement has relied upon short-term testing and structure activity relationship (SAR) analogies to classify 1,2,3-trichloropropane as a possible carcinogen.[1]

In regard to the use of structure activity relationships, Dr. John Moore, EPA's Assistant Administrator for Pesticides and Toxic substances stated in June 1984 that:

> "SAR is not capable of 'proving' anything. It is useful to the regulator in suggesting substances which could pose a particular danger of toxicity to humans or the environment. However, in my view, we are a long way from a time when SAR will be so highly refined that we will be able to dispense with experimentation altogether. The chances of error - both false positive and false negative - are simply too great."

The implication of wrongly including TCP as a carcinogen is clear when the ICF-SRW Associates Excavation Volume Study (1986) is reviewed. If TCP was deleted from the list of carcinogenic indicators at the site, only a very small area of the lagoons or the contaminated soils would require excavation, assuming that the remaining calculations are accurate.

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[1]In selecting 1,2-dichloropropane as a structurally similar analog, EPA depends upon a memorandum from Dr. Craig Zamuda of EPA Headquarters, dated December 23, 1985. Dr. Zamuda was unavailable for comment on this memorandum on several occasions, did not return calls, and thus clarification or a copy of this memorandum could not be obtained. Based upon current Endangerment Assessment Methodology for toxicological reviews (i.e., Endangerment Assessment Handbook and Toxicology Handbook: Principles Related to Hazardous Waste Site Investigations) the toxicological information of 1,2-dichloropropane and 1,2,3-trichloropropane is very limited and thus, falls short of the required toxicological evaluation examples in these handbooks. Dr. Zamuda is the Project Officer on EPA's Draft

Superfund Public Health Evaluation Manual which was issued for review on December 18, 1985. In that manual, 1,2-dichloropropane is listed as a non-carcinogen and is not contained in the list of carcinogens and is consistent with other literature sources. Sittig (1985) discusses 1,2-dichloropropane, but does not mention carcinogenicity. ACGIH in Threshold Limit Values and Biological Exposure Indices,: 1986-87, propose an eight hour time weighted average (TWA) of 75 ppm and do not include it in their listings of known or suspected human carcinogens.

SECTION 8

EVALUATION OF ALTERNATIVES NOT CONSIDERED BY EPA

8.1 Introduction and Objective

The primary health risk posed by the site as identified in the RI/FS is from direct contact of trespassers with soils. This risk could be remediated by a cap or by air stripping of the contaminants from the soils. This section discusses and evaluates the effectiveness of a cap in reducing infiltration and describes the air stripping tests conducted on on-site soils by AWARE, Inc. for CIBA-GEIGY Corporation.

8.2 Effectiveness of a Cap

The primary advantages of a capping alternative over excavation are: 1) exposure due to volatilization will be essentially eliminated; 2) there will be no disruption of the neighborhood, including traffic and temporary evacuation; and 3) A cap will decrease infiltration and result in a lower rate of mobilization of contaminants than presently occurs.

In the following discussion, two typical cap designs are evaluated in terms of their effectiveness in reducing infiltration. Infiltration through the caps is determined using the Hydrologic Evaluation of Landfill Performance (HELP) model. The quantity of infiltration calculated with the HELP model is compared to the infiltration given in the ICF-Clement RA.

ERM considers the water balance a crucial step in the modeling procedure. The water balance should be developed carefully using site-specific data since the selection of the remedial action is sensitive to the balance. Net infiltration, obtained from the water balance defines the initial flux of contaminants into ground water in the model EPA employs. Although ICF-Clement cautions EPA on the need for further investigation to define this parameter, an arbitrary value of infiltration was chosen by EPA. A large cap over the site may reduce local recharge and result in a thickening of the vadose zone under the site. It may also reduce seasonal variations in water table elevations and decrease the possibility of ground water intersection with wastes. This promising aspect of capping was not previously considered by EPA.

A more detailed analysis of the hydrogeology at Tyson's Site is required to quantify these effects.

8.2.1 Typical Landfill Cover

A typical landfill cover is composed of a top layer of soil capable of supporting a vegetative cover of grass, a drainage layer and a low permeability soil liner. No synthetic membrane is employed in the design. The top layer is a 24-inch thick silt/loam with an effective hydraulic conductivity of .33 inches/hr. The drainage layer is a coarse sand with a bottom slope of 3% and hydraulic conductivity of 11.95 inches/hr. The bottom layer is an especially prepared low-permeability barrier soil with a 1.4×10^{-4} inch/hr. hydraulic conductivity.

8.2.2 RCRA Cap

A RCRA cap is very similar to a typical landfill cover with one exception. The barrier soil layer is replaced with an impermeable membrane liner of 50 mil HDPE. To estimate percolation through the RCRA cap it is necessary to estimate some leakage fraction or failure rate of the liner. Without failure or leakage no infiltration occurs and no ground water pollution will result. A properly installed 50 mil HDPE liner should not leak, and there is no "rule of thumb" to assign a leakage factor. In this analysis a value of 10 percent for the leakage fraction was assumed.Using the average percolation rates from Table 8-1, the annual volumes of total infiltration through the caps can be determined. These values are shown in Table 8-2.

TABLE 8-1

Percolation Through Various Landfill Caps in inches per year (in/yr)

Year	Typical Cap (in/yr)	RCRA Cap (in/yr)
1974	1.58	.60
1975	1.81	1.33
1976	1.72	.85
1977	1.68	.89
1978	1.82	1.34
Average	1.72	1.01

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TABLE 8-2

Treatment	Volume of Infiltration
Typical Cap	11.5% of RA
RCRA Cap	- negligible - assuming a 10% failure rate infiltration equals 6.7% of RA
Risk Assessment Document	676.2 gpd = 100%

8.3 Vapor Stripping of Soils

AWARE Corporation has conducted laboratory tests on the effectiveness of vapor stripping using on-site soils. In this process, clean air is mechanically injected into the contaminated in-place soils and forced to travel through the soils, volatilizing the trapped VOCs. Contaminated air is withdrawn from the soils and can be vented to an emission control system.

Preliminary results of the plot tests using on-site soils conducted by AWARE Corporation indicate that greater than 90 percent of total VOCs can be removed. Further work will be carried out to optimize the removals. This alternative is considered more attractive then excavation because contaminants can be permanently removed from contact with ground waters. Excavation merely transfers contaminants to other sites where they may leach into ground waters.

8.4 Summary

EPA should have considered the effectiveness of a cap and of vapor stripping in protecting ground water.

A well-designed cap would have a low probability of failure and would generate no infiltration. Assuming a very conservative estimate of 10 percent, the amount of infiltration is reduced to 6.7 percent of the infiltration value used by EPA. This reduction, together with the other previously stated benefits of capping make it a technically sound and cost effective alternative. The increased cost of EPA's selected alternative versus the capping alternative offers questionable benefits. In addition the nature and extent of contamination in the bedrock aquifer requires additional investigation. The capping alternative should, at a minimum be considered as a temporary action until a more complete definition of the problem posed by the site can be investigated.

Preliminary pilot tests of vapor stripping of on-site soils conducted by AWARE Corporation have achieved greater than 90 percent removal of VOCs. This technique prevents contaminants from affecting ground water, and is, therefore, preferable to excavation in the future.

RESUME

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Education

B.S. Geology/Chemistry, Youngstown State University, Youngstown, Ohio, 1973.
M.S. Geology/Chemistry, Wright State University, Dayton, Ohio, 1976.

Professional History

Research Assistant, Illinois State Geological Survey, 1976-1978
Research Associate, Illinois State Geological Survey, 1978-1979
Assistant Geochemist, Illinois State Geological Survey, Head of Environment Geology Unit, 1979-1981.
Project Manager, SMC Martin, Inc., 1981-1983
Project Manager, Environment Resources Management, Inc., 1983-Present

Technical Specialties

Design and installation of monitoring well networks and the collection of all types of environmental and hazardous waste samples. Management of multi phase investigations including, Remedial Investigation and Feasibility Studies (RI/FS).

Inorganic and organic contaminant migration investigations including geochemical modeling to determine migration patterns and controls on inorganic constituent concentrations in subsurface environments. Characterization and interpretation of potential hazards from industrial/hazardous waste facilities and coal-related solid wastes. Development of ground water sampling techniques for organic and inorganic constituents in both the saturated and unsaturated zones.

Development of company wide Health and Safety and Quality Assurance Program; fully safety trained for work at Hazardous Waste Sites.

Representative Project Experience

- 1985 Managed all aspects of RI/FS investigation for responsibile party abandoned hazardous waste disposal facility in Pennsylvania. Site ranked very high on National Priorities List (NPL).

- 1985 Managed all aspects of RI/FS investigation for responsible party at industrial facility in Southern New Jersey. Site on NPL.

- 1985 Developed company Health and Safety Program including; personnel training, medical monitoring, and preparation of company Health and Safety manual.

- 1984 Managed sampling and analysis program in a Northern New Jersey community which included the sampling of 200 residential wells.

- 1984 Conducted ECRA investigation of a 200 acre industrial property.

- 1983 Managed all aspects of RI/FS investigation for a responsible party at a former chemical manufacturing facility in eastern Ohio. Site ranked very high on NPL.

- 1983 Developed Company Quality Assurance Program and Standard Operating Procedures for the collection of representative environmental samples.

- 1983 Conducted investigation into the impact of landfill top sealing on ground water quality.

- 1982 Managed projects for Region V U.S. EPA Underground Injection Control program including; Class I, II, and IV well inventories and assessments.

- 1982 Presented four day training seminars for U.S. EPA Regional V technical staff on "Methods for the Collection of Representative Environmental Samples" and "Principals of Contaminants Migration."

- 1981 Managed Office of Surface Mining funded research in the development of methods for sampling coal related waste sources.

- 1981 Conducted research on the characterization and toxicity of fly ash and their leachates.

- 1980 Conducted research on the proper use and installation of pressure-vacuum lysimeter.

- 1980 Managed U.S. EPA research project on the chronic toxicity of coal related waste leachates.

- 1979 Developed methods for the U.S. EPA for the collection of representative ground water samples from monitoring wells.

- 1978 Investigated the use of various laboratory leachate generation procedures for simulating the waste streams generated from coal related wastes.

- 1978 Conducted geochemical modeling to determine the controls on solubility of coal related waste leachate constituents.

- 1977 Investigated the characterization and acute toxicity of liquification and gasification byproducts.

Presentations/Publications

Schuller, R.M., Brent E. Huntsman, Beverly J. Warner, and Phillip G. Mallone. 1975. Rapid On-Site Electrode Technique for Determining Copper in Soil for Geochemical Exploration. Abstracts from the 1975 Annual Meeting of the Geological Society of America, Salt Lake City, Utah.

Griffin, R. A., R. M. Schuller, J. Suloway, S. J. Russell, W. F. Childers, and N. F. Shimp. 1978. Solubility and Toxicity of Potential Pollutants in Coal Solid Wastes. In Environmental Aspects of Fuel Conversion Technology, III, Environmental Protection Technology Series. U.S. EPA, Research Triangle Park, NC. EPA-600/7/78-063.

Schuller, R. M. , R. A. Griffin and J. J. Suloway. 1979. Chemical and Biological Characterization of Leachate from Coal Cleaning Wastes. In Coal Cleaning to Achieve Energy and Environmental Goals, J. D. Kilgroe, Ed., U.S. EPA Research Triangle Park, NC. EPA-600/7-79-098b.

Griffin, R. A., R. M. Schuller, S. J. Russell, and N. F. Shimp. 1979. Chemical Analysis and Leaching of Coal Conversion Solid Wastes. In Research Symposium Environmental Aspects of Fuel Conversation Technology IV., U.S. EPA Reseach Triangle Park, NC. EPA-600/7-79-217.

Schuller, R. M., J. J. Suloway, R. A. Griffin, S. J. Russell, and W. F. Childers. 1979. Identification of Potential Pollutants from Coal Conversion Wastes. Society of Mining Engineers of AIME, Transactions vol. 268, p. 1776-1780.

Schuller, R. M. 1980. Preservatioon, Storage, and Analysis of Ground Water Samples and Leachates. National Council of the Paper Industry for Air and Stream Improvement, Inc. Technical Workshop for Ground Water Quality Monitoring at Land Disposal Sites, Des Plaines, Illinois, January 17-18.

Gibb, James P., R. M. Schuller, and R. A. Griffin. 1980. Monitoring Well Sampling and Preservation Techniques. In Disposal of Hazardous Wastes: Proceedings of the Sixth Annual Research Symposium, U.S. EPA, Cincinnati, Ohio. EPA-600-9-80010.

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Griffin, R. A., R. M. Schuller, J. J. Suloway, N. F. Shimp, W. F. Childers and R. H. Shiley. 1980. Chemical and Biological Characterization of Leachates from Coal Solid Wastes. Environmental Geology Notes 89, Illinois Institute of Natural Resources, State Geological Survey Division, Champaign, Illinois.

Suloway, J. J., R. M. Schuller, T. Skelly and R. A. Griffin, 1980. The Acute Toxicity of Leachates Generated from Coal Solid Wastes. 42nd Midwest Fish and Wildlife Conference, St. Paul, Minnesota, December 9-12.

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Roy, W. R., R. Thiery, R. M. Schuller, and J. J. Suloway. 1981. Sampling Techniques and Materials. Presented at the National Ground Water Monitoring Symposium, Columbus, Ohio, May 29-30.

Johnson, T. M., K. Cartwright and R. M. Schuller. 1981. Monitoring of Leachate Migration in the Unsaturated Zone in the Vicinity of Sanitary Landfills. Ground Water Monitoring Review, vol. 1, no. 3.

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Suloway, J., T. Skelly, R. Schuller, and R. Griffin. 1981. The Acute Toxicity of Leachate Generated from Coal Solid Wastes. American Fisheries Society 777th Annual Meeting, Albuquerque, New Mexico, September 15-18.

Roy, W. R., J. J. Suloway, I. G. Krapac, T. M. Skelly, R. A. Griffin, D. R. Dickerson, R. M. Schuller, and N. F. Shimp. Geochemical and Toxicological Properties at Coal and Solid Wastes. Illinois State Geological Survey Environmental Geology Notes. (in print)

Krapac, I. G., D. R. Dickerson, R. M. Schuler, and R. A. Griffin. Chemical Characterization of a Coal Gasification Solid Residue and Aqueous Extracts. (in print)

Schuller, R. M., W. W. Beck, Jr. D. R. Price. 1982. Case Study of Contaminant Reversal and Ground-Water Restoration in a Fractured Bedrock. Conference Proceedings 3rd National Conference on "Management of Uncontrolled Hazardous Waste Sites, "Washington, DC, November 29-October 1.

Schuller, R. M., A. L. Dunn, and W. W. Beck, Jr. 1983. The Impact of Top-Sealing at the Windham, Connecticut Landfill. U. S. EPA Ninth Annual Research Symposium on the Treatment and Disposal of Hazardous Waste.

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<u>Affiliations</u>

National Water Well Association
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The ERM Group

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Experience Summary:

Over twenty years of diversified experience with regulatory agencies and consulting firms; formulation of regulatory policy; project execution in the areas of ground water resource evaluation, development and management; solid/liquid waste disposal siting, pollution assessment, and remedial action.

Fields of Competence:

Management, direction, and quality assurance of hydrogeologic projects; hydrogeologic assessment and environmental impact of existing and proposed waste disposal facilities with emphasis on hazardous waste facilities; ground water resource and flow system analysis, delineation, recovery, and containment of hydrocarbon and hazardous material spills; photogeologic interpretation; and expert testimony.

Education:

B.S., Geology and Mineralogy, Pennsylvania State University, 1961
M.S., Geology (Hydrogeology), Pennsylvania State University, 1963

Employment History:

1978 to Present

Environmental Resources Management, Inc.
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Principal

Responsible charge for management of Geology Group, client/project development, conduct and review of technical/financial aspects of projects and quality assurance; expert testimony.

1975 to 1978	Roy F. Weston, Inc. West Chester, PA Assistant Manager/Manager-Earth Science Department Responsible charge for client/project development, conduct and review of technical/financial aspects of projects and quality assurance; expert witness.
1969 to 1975	Moody and Associates, Inc. Harrisburg, PA Geologist/Vice President Responsible charge for client/project development, conduct and review of technical/financial aspects of projects and quality assurance; expert witness.
1968 to 1969	Pennsylvania Department of Environmental Resources (formerly Department of Health) Harrisburg, PA Geologist Technical execution in regulatory/enforcement program including formulation of policy and expert witness.
1963 to 1968	Illinois State Geological Survey Champaign, IL Associate Project Geologist Technical execution in applied projects and assistance to Illinois EPA, hydrogeology of sanitary landfills in northeastern Illinois.

Registration/Certification:

Delaware, Georgia, Indiana, and Virginia

Professional Affiliations:

American Institute of Professional Geologists
Association of Engineering Geologists
National Water Well Association

Awards and Publications:

C. P. Holdredge Award for Association of Engineering Geologists (1972) for most significant technical contribution (co-authored) to the literature entitled "Hydrogeology of Solid Waste Disposal Sites in Northeastern Illinois".

Author and co-author of numerous papers dealing with solid waste management, plus numerous papers given at technical meetings.